MULTIMEDIA UNIVERSITY ™

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

EEL2046 – ENERGY CONVERSION II

(LE)

17 MARCH 2018
2.30 P.M – 4.30 P.M
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question Paper consists of 3 pages including the cover page with 4 Questions only.

2. Answer **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print your answers in the Answer Booklet provided.

Question 1

(a) i. Classify DC Generators on the basis of interconnections between the field and armature windings.

[3 Marks]

ii. Sketch cross section of a 1-pole pair non-salient rotor DC Generator. Also indicate in the sketch it's four mmf axis's.

[4 Marks]

(b) A 4-pole DC shunt generator with 400 lap connected winding has a shunt field winding resistance of 200Ω and an armature resistance of 1 Ω. A load of 10 Ω is connected across the armature and the generator is driven at 1800 rpm. Assume the flux/pole is 20mWb and the rotational loss is 480 W.Determine

i. the induced voltage, [3 Marks]
ii. the terminal voltage and [3 Marks]
iii. the input power. [4 Marks]

(c) A long shunt compound DC generator has an armature resistance of 0.04 Ω, series field resistance of 0.05 Ω and field resistance of 200 Ω. It supplies a power of 10 kW at a terminal voltage of 200 V to a load. Draw the electrical equivalent circuit and mark all the parameter values. Determine its armature current and generated emf.

[8 Marks]

Question 2

(a) Draw the equivalent circuit diagrams of DC series motor and DC shunt motor clearly indicating the armature and field parameters and sketch their speed versus armature current characteristics.

[9 Marks]

(b) A DC series motor operates at 800 rpm with a line current of 120 A from 250 V mains. Determine the motor speed a current of 60 A at 250 V assuming that the flux per pole at 60 A is 70% of its value at 120 A. R_a= 0.15 Ω and R_s = 0.1 Ω.

[9 Marks]

(c) A 240 V, 1500 rpm dc shunt motor has a rated armature current of 150 A and a rated field current of 4.8 A. The armature and the field resistances are 0.07 Ω and 50 Ω, respectively. At no load with the terminal voltage equal to 240 V, the armature current is 8 A. Compute the efficiency of the machine when the motor is operating at rated condition.

[7 Marks]

Continued...

Question 3

(a) State 3 methods of speed control in a squirrel cage motors.

[6 Marks]

(b) A 120-V, 1/3 hp, 50Hz, four-pole, split-phase induction motor has the following main-winding impedances:

$R_1 = 2.0\,\Omega \quad X_1 = 2.56\,\Omega \quad X_m = 60.5\,\Omega$
$R_2 = 2.8\,\Omega \quad X_2 = 2.56\,\Omega$

The core losses of this motor are 30 W, and the friction, windage, and stray losses are 20 W. The motor is operating at the rated voltage and frequency with its starting winding open, and the motor's slip is 5 percent. Find the following quantities in the motor at these conditions:

i. Speed in revolutions per minute [2 Marks]
ii. Stator current in amperes [2 Marks]
iii. Stator power factor (θ) [2 Marks]
iv. Input Electrical Power (P_{in}) [2 Marks]
v. Total Air-Gap Power (P_{AG}) [2 Marks]
vi. Power Converted (P_{conv}) [2 Marks]
vii. Torque Induced (τ_{ind}) [2 Marks]
viii. Output Power at the shaft (P_{out}) [2 Marks]
ix. Output Torque at the shaft (τ_{load}) [1 Marks]
x. Motor Efficiency (η) [2 Marks]

Question 4

(a) A 2-phase, 1-pole paired rotor stepper motor is controlled using an uni-polar PLC control driver. Draw the cross section of the stepper motor indicating the poles. Sketch the required stepper motor input signals timing diagram showing step size versus number of poles for full 360° turn for below modes;

i. Full stepping drive and,
ii. Half stepping drive.

Also calculate the steeping interval (θ_m) and number of position required for both modes (i) and (ii).

[16 Marks]

(b) What changes are necessary in a dc series motor to use it as a universal motor?

[4 Marks]

(c) A three-phase moving-rail Linear Induction Motor has three poles and a pole pitch of 0.21 m. The motor is operated from a 50 Hz system. Determine

i. Synchronous Speed in m/s. [2 Marks]
ii. The rail speed in km/h if the slip of the motor is 16% [3 Marks]

End of Paper